OPTICAL ELEMENT, SURFACE LIGHT SOURCE DEVICE AND LIQUID CRYSTAL DISPLAY(LCD) DEVICE

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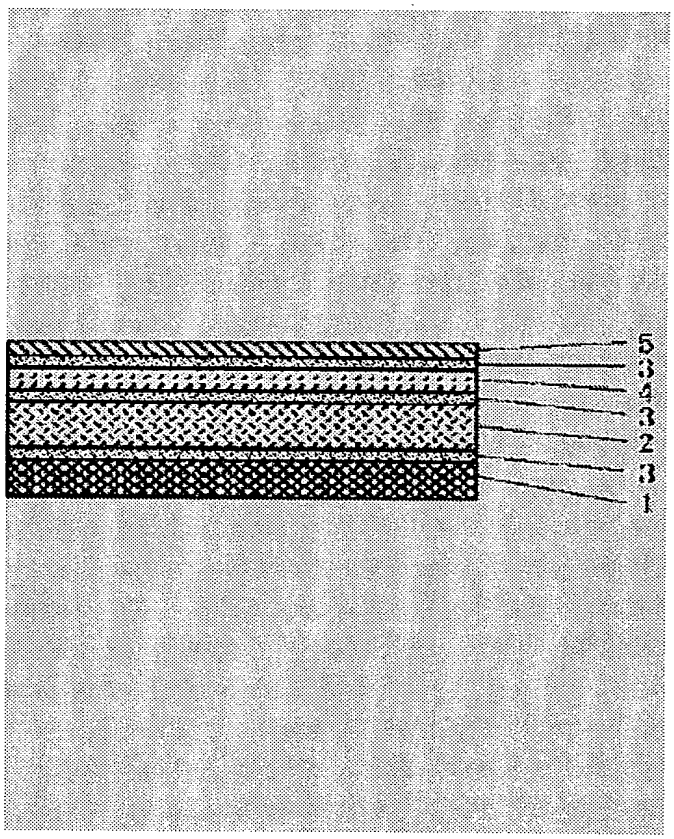
Abstract of **JP2002090535**

PROBLEM TO BE SOLVED: To provide an optical element capable of forming a surface light source device, which hardly cause degradation of performance of damage to a shape due to adhesion to adjacent members, has excellent workability is handling and emits light with excellent forward directivity, and an LCD device excellent luminance. SOLUTION: The optical element comprises cholesteric liquid crystal layers (1, 2) with Grandjean orientation which are mutually laminated, in combination of the selective reflection wavelength regions of circularly polarized light common to each other and with the left- or right-handed polarization of the circularly polarized light reversed by the selective reflection, or in combination of the selective reflection wavelength regions common to each other and with the left- or right-handed polarization of the circularly polarized light unchanged by the selective reflection via a half-wave plate. The surface light source device comprises the optical element arranged on a sidelight type or a direct lower type surface light source provided with a fluorescent lamp composed of a tube with three wavelengths as a light source. The optical element forms the LCD device. In the optical element and the devices, the light in a specified wavelength region transmitting through the first cholesteric liquid crystal layer is selectively reflected and shielded by the second cholesteric liquid crystal layer.



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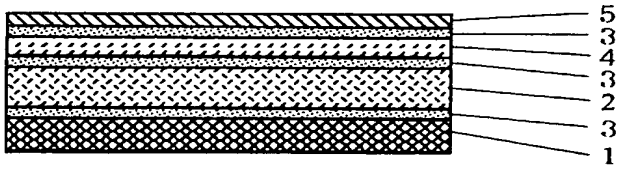
(54)【発明の名称】　光学素子、面光源装置及び液晶表示装置

(57)【要約】
【課題】　隣接部材との密着による性能低下や形態の損傷を生じにくくて取扱作業性に優れると共に、正面指向性よく発光する面光源装置や輝度に優れる液晶表示装置を形成しうる光学素子の開発。
【解決手段】　グランジャン配向のコレステリック液晶層（１、２）を円偏光の選択反射波長域が同じとなりかつ選択反射の円偏光の左右が逆転する組合せで積層又は選択反射波長域かつ選択反射の円偏光の左右が同じとなる組合せで１／２波長板を介し積層してなる光学素子、その光学素子を三波長管よりなる蛍光灯を光源とするサイドライト型又は直下型の面光源上に配置してなる面光源装置及び前記の光学素子を用いてなる液晶表示装置。
【効果】　先のコレステリック液晶層を透過した特定波長域の光が後のコレステリック液晶層で選択反射されて遮光される。



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【特許請求の範囲】

【請求項１】　グランジャン配向のコレステリック液晶層を、円偏光の選択反射波長域が同じとなり、かつ選択反射される円偏光の左右が逆転する組合せで積層してなることを特徴とする光学素子。

【請求項２】　グランジャン配向のコレステリック液晶層を、円偏光の選択反射波長域かつ選択反射される円偏光の左右が同じとなる組合せで１／２波長板を介し積層してなることを特徴とする光学素子。

【請求項３】　請求項１又は２において、円偏光の選択反射波長域が５５０～６１０nmの範囲内にあるコレステリック液晶層と６１０～８００nmの範囲内にあるコレステリック液晶層、又はそれらと４４０～５５０nmの範囲内にあるコレステリック液晶層を用いたものである光学素子。

【請求項４】　請求項１～３において、最外層のコレステリック液晶層の外側に粘着層を介して二色性偏光板が接着された光学素子。

【請求項５】　請求項４において、二色性偏光板を有する側に１層又は２層以上の位相差板が粘着層を介して接着された光学素子。

【請求項６】　請求項１～５に記載の光学素子を三波長管よりなる蛍光灯を光源とするサイドライト型又は直下型の面光源上に配置してなることを特徴とする面光源装置。

【請求項７】　請求項１～５に記載の光学素子を用いてなることを特徴とする液晶表示装置。

【発明の詳細な説明】

【０００１】

【発明の技術分野】本発明は、正面指向性よく発光する面光源装置や輝度に優れる液晶表示装置を形成しうるリオフィルター型の光学素子に関する。

【０００２】

【発明の背景】従来、サイドライト型導光板等の面光源による発散光の正面指向性を高めて正面輝度の向上を図りうる光学素子としては、プリズムシートが知られていた（特開平１０－６８８０４号公報、特開平１０－８２９０２号公報）。プリズムシートは、透明基材上に山形のプリズム形態をアレイしたものでそのプリズム形態を介し斜め方向の光を屈折させて面光源の正面（垂直）方向に向けその正面指向性を高めるものである。２枚以上のプリズムシートをそのプリズムのアレイ方向が交差するように重畳して多方向に発散する光を正面方向に集光する方式も知られている。しかしながらプリズムシートは、そのプリズム形態が接触等で傷付きやすくその傷付きは輝点や暗点の発生原因となるため面光源装置の組立時等に注意を要して取扱い難く作業性に乏しい問題点があった。また実用時にプリズムシートがフィルム等の隣接部材と密着するとプリズム機能が低下して性能低下を生じやすい問題点もあった。

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【０００３】一方、液晶表示装置等の高輝度化を図る手段としては、面光源上にグランジャン配向のコレステリック液晶層と１／４波長板からなる光学素子を配置する方式も知られていた。この方式は、前記コレステリック液晶層が示す入射自然光を反射光と透過光として左右の円偏光に分離する性質を利用して、面光源による出射光を円偏光化しそれを１／４波長板を介し直線偏光化して偏光板に供給することにより偏光板による吸収ロスを抑制して輝度を向上させるようにしたものである。従って面光源による発散光の正面指向性の向上には寄与しない。

【０００４】

【発明の技術的課題】本発明は、隣接部材との密着による性能低下や形態の損傷を生じにくくて取扱作業性に優れると共に、正面指向性よく発光する面光源装置や輝度に優れる液晶表示装置を形成しうる光学素子の開発を課題とする。

【０００５】

【課題の解決手段】本発明は、グランジャン配向のコレステリック液晶層を、円偏光の選択反射波長域が同じとなり、かつ選択反射される円偏光の左右が逆転する組合せで積層してなる、又は当該コレステリック液晶層を円偏光の選択反射波長域かつ選択反射される円偏光の左右が同じとなる組合せで１／２波長板を介し積層してなることを特徴とする光学素子、及びその光学素子を三波長管よりなる蛍光灯を光源とするサイドライト型又は直下型の面光源上に配置してなることを特徴とする面光源装置、並びに前記の光学素子を用いてなることを特徴とする液晶表示装置を提供するものである。

【０００６】

【発明の効果】本発明によればグランジャン配向のコレステリック液晶層による特定波長域の左右一方の円偏光を選択的に反射しかつ他の光は透過させる特性、及びその左右の円偏光に対する組合せに基づいて、前記特定波長域の光を選択反射して実質的に遮光することができる。なお前記左右の円偏光に対する組合せは、選択反射される円偏光の左右が逆転する組合せに加えて、その円偏光の左右が同じとなる組合せであっても１／２波長板を介在させることで円偏光の左右を逆転させることができてその目的を達成することができる。

【０００７】また前記の場合にコレステリック液晶層では入射角θに応じcosθの関係で選択反射の波長域が短波長側にシフトする特性を示すことから、コレステリック液晶層の選択反射波長域を制御することで正面方向（入射角０度）では所定波長域の光が透過し、その光が所定値以上の入射角θで入射したときには前記の遮光効果を生じさせて正面と入射角が一定値以内の方向の光のみが透過するものとすることができる。

【０００８】従って前記の入射角θが所定値以上の入射光に対して遮光効果を示す光学素子と、その遮光効果を

生じる波長光で発光する面光源を組合せることにより正面指向性よく発光する面光源装置を形成でき、それを用いて輝度に優れる液晶表示装置を形成することができる。また本発明による光学素子は、隣接部材と密着しても性能低下を生じず、また突起等の損傷を生じやすい形態を有しないので取扱作業性にも優れている。

【０００９】

【発明の実施形態】本発明による光学素子は、グランジャン配向のコレステリック液晶層を、円偏光の選択反射波長域が同じとなり、かつ選択反射される円偏光の左右が逆転する組合せで積層したもの、又は当該コレステリック液晶層を円偏光の選択反射波長域かつ選択反射される円偏光の左右が同じとなる組合せで１／２波長板を介し積層したものよりなる。その例を図１、図２に示した。１、２がコレステリック液晶層、６が１／２波長板である。また３は粘着層、４は二色性偏光板、５は位相差板である。

【００１０】グランジャン配向のコレステリック液晶層は、その螺旋ピッチＰに基づき式：$\lambda = n \cdot P \cdot \cos\theta$ にて算出される円偏光をブラッグ反射により選択的に反射し他の光は透過する（ただし、λは反射光の中心波長、ｎはコレステリック液晶分子の平均屈折率（ｎ＝（ｎｅ＋ｎｏ）／２）、θは光の入射角である）。反射される円偏光の左右は、グランジャン配向のコレステリック液晶層における螺旋方向の左右で決定される。また選択反射波長域$\triangle\lambda$は、液晶の屈折率差$\triangle n$により式：$\triangle\lambda = \triangle n \cdot P \cdot \cos\theta$に基づいて中心波長$\lambda$の近傍に形成される。

【００１１】本発明においてグランジャン配向のコレステリック液晶層は、図１の例の如く円偏光の選択反射波長域が同じとなりかつ選択反射される円偏光の左右が逆転する組合せ（１、２）、又は図２の例の如く円偏光の選択反射波長域かつ選択反射される円偏光の左右が同じとなる組合せ（１）で用いられ、後者の円偏光の左右が同じとなる組合せでは１／２波長板６を介して積層される。これにより同じ選択反射波長域において左右いずれの円偏光も反射する光学素子が形成され、当該波長域の光の透過が阻止される。なお前記後者の場合には１／２波長板が先のコレステリック液晶層を透過した円偏光の左右を逆転させることに基づいて後のコレステリック液晶層で反射されることとなる。

【００１２】用いるグランジャン配向のコレステリック液晶層については、特に限定はなく上記した特性を示す適宜なものを用いうる。コレステリック液晶層は、単層物であってもよいし、グランジャン配向の螺旋ピッチが相違するもの、従って選択反射の波長域が相違するものの組合せにて２層又は３層以上を重畳した配置構造を有するものであってもよい。かかる重畳化にて選択反射の波長域を拡大することができる。

【００１３】前記した螺旋ピッチ相違のコレステリック液晶層の重畳に際し、螺旋ピッチの大小に基づく重畳の順序については特に限定はなく、任意な重畳順序とすることができる。一般には螺旋ピッチが大小の順序通りとなるように重畳することが光利用効率の向上、ひいては輝度向上の点より有利な場合が多い。

【００１４】なお上記した選択反射される円偏光の左右が逆転する組合せのコレステリック液晶層による光学素子を形成するときにも、前記した螺旋ピッチ相違のコレステリック液晶層の重畳方式を採りうるがその場合には、円偏光の左右が逆転するものの交互重畳方式や同じ円偏光方向のものの重畳一体化方式などの適宜な方式を採ることができ、螺旋ピッチの大小の順序を含めてその重畳方式に特に限定はない。

【００１５】グランジャン配向のコレステリック液晶層は、低分子液晶をセル基板で狭持したセル形態のものとして得ることもできるが、取扱性や薄型化等の点よりはフィルム状ないしシート状としたものが好ましく用いられる。フィルム状等のコレステリック液晶層は、例えば液晶ポリマーによるフィルム、透明基材上にラビング処理等による配向膜を介しグランジャン配向させた液晶ポリマーによる層を付設したもの、透明基材上に配向膜を介しグランジャン配向させた低分子液晶の紫外線硬化層を付設したものなどとして得ることができる。またコレステリック液晶層の重畳層は、重ね塗り方式や別途形生物の融着方式などにより形成することができる。なお螺旋方向が逆巻きのコレステリック液晶層（円偏光の左右が逆転）の重畳層は、別途形生物を粘着層等の透明接着層を介して行うことができる。

【００１６】前記の透明基材を形成する材料については特に限定はないが一般にはポリマーが用いられる。そのポリマーの例としては、二酢酸セルロースや三酢酸セルロースの如きセルロース系ポリマー、ポリエチレンテレフタレートやポリエチレンナフタレートの如きポリエステル系ポリマー、ポリカーボネート系ポリマーやポリメチルメタクリレートの如きアクリル系ポリマー、ポリスチレンやアクリロニトリル・スチレン共重合体の如きスチレン系ポリマー、ポリエチレンやポリプロピレン、シクロ系ないしノルボルネン構造を有するポリオレフィンやエチレン・プロピレン共重合体の如きオレフィン系ポリマー、塩化ビニル系ポリマー、ナイロンや芳香族ポリアミドの如きアミド系ポリマーがあげられる。

【００１７】またイミド系ポリマーやスルホン系ポリマー、ポリエーテルスルホン系ポリマーやポリエーテルエーテルケトン系ポリマー、ポリフェニレンスルフィド系ポリマーやビニルアルコール系ポリマー、塩化ビニリデン系ポリマーやビニルブチラール系ポリマー、アリレート系ポリマーやポリオキシメチレン系ポリマー、エポキシ系ポリマーや前記ポリマーのブレンド物、あるいはポリエステル系やアクリル系、ウレタン系やアミド系、シリコーン系やエポキシ系等の熱や紫外線照射等で硬化す

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るポリマーなども前記透明基材の形成に用いうる。就中セルロース系フィルムの如く等方性に優れる、ないし複屈折の少ない透明基材が好ましく用いられる。

【００１８】図２の例の如く上記したコレステリック液晶層１を選択反射される円偏光の左右が同じとなる組合せで用いて１／２波長板６を介し積層して、透過円偏光の左右を逆転させるための１／２波長板としては、各種ポリマーの延伸フィルム等からなる複屈折性フィルム、ディスコチック系やネマチック系の如き液晶ポリマーの配向フィルム、その配向液晶層を透明基材上に支持したものなどの従来に準じた適宜なものを用いうる。

【００１９】前記の複屈折性フィルムを形成するポリマーは、上記した透明基材で例示したものなどの適宜なものであってよい。就中、例えばポリエステル系ポリマーやポリエーテルエーテルケトンの如く結晶性に優れるポリマーが好ましく用いうる。延伸フィルムは一軸や二軸等の適宜な方式で処理したものであってよい。また熱収縮性フィルムとの接着下に収縮力又は／及び延伸力を付与する方式などによりフィルムの厚さ方向の屈折率を制御した複屈折性フィルムなどであってもよい。さらに１／２波長板は、例えば位相差相違の位相差板を光軸を交差させて積層したものの如く、１／２波長板として機能する波長域を拡大したものであってもよい。

【００２０】図１の例の如く光学素子は、必要に応じ最外層のコレステリック液晶層の外側に粘着層３を介して二色性偏光板４や、さらにはその二色性偏光板を有する側に粘着層３を介して１層又は２層以上の位相差板を接着した形態で実用に供することもできる。斯かる二色性偏光板等との一体化は取扱作業性がより向上し、また面光源装置や液晶表示装置等の組立工程を簡易化することができる。

【００２１】前記の二色性偏光板は、液晶表示等を達成するための直線偏光を得ることを目的とするものである。その偏光板には所定偏光軸の直線偏光を透過して他の光は吸収する適宜なものを用いることができその種類について特に限定はない。一般には偏光フィルムやその片面又は両面を透明保護層で保護したものなどが用いられる。ちなみにその偏光フィルムの例としては、ポリビニルアルコール系フィルムや部分ホルマール化ポリビニルアルコール系フィルム、エチレン・酢酸ビニル共重合体系部分ケン化フィルムの如き親水性高分子フィルムにヨウ素及び／又は二色性染料を吸着させて延伸処理したものなどがあげられる。

【００２２】また偏光フィルムの片面又は両面に必要に応じて設ける透明保護層は、上記の透明基材で例示したポリマーなどにて形成することができる。就中、透明性や機械的強度、熱安定性や水分遮蔽性等に優れるポリマーからなる透明保護層が好ましい。透明保護層は、ポリマー液の塗布方式やフィルムとしたものの接着積層方式などの適宜な方式で形成することができる。

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【００２３】一方、上記した必要に応じての位相差板は、液晶セルの複屈折による位相差を補償して表示品位の向上を図ることなどを目的とするものである。かかる光学補償用の位相差板は通例、表示品位の向上の点より二色性偏光板と液晶セルの間に位置するように配置することが好ましい。光学補償用の位相差板としては、上記の１／２波長板に準じた複屈折性フィルムや配向液晶層などからなる適宜な位相差を有するものが用いられ、位相差等の光学特性の制御を目的に２層以上の位相差層を積層したものであってもよい。

【００２４】また前記の位相差板は、コレステリック液晶層より出射される透過円偏光を直線偏光化するための１／４波長板であってもよい。その場合、１／４波長板からなる位相差板は通例、コレステリック液晶層と二色性偏光板の間に配置される。１／４波長板を介し直線偏光化した光をその振動面が二色性偏光板の透過軸と可及的に一致するように供給することで吸収ロスを防止して輝度をより高めることができる。前記の１／４波長板は、１／２波長板と重畳する方式などで１／４波長板として機能する波長域の拡大を図ったものなどであってもよい。

【００２５】光学素子を形成するコレステリック液晶層や１／２波長板、必要に応じての二色性偏光板や位相差板等の各素材は単に重ね置いたものであってもよいが、光軸のズレ防止による品質の安定化や液晶表示装置の組立効率の向上などの点より粘着層等の透明接着層を介して積層一体化されていることが好ましい。ちなみに図例では、コレステリック液晶層の１と２や１／２波長板６、二色性偏光板４や位相差板５がそれぞれ粘着層３を介して接着一体化されている。

【００２６】粘着層は、例えばアクリル系重合体やシリコーン系ポリマー、ポリエステルやポリウレタン、ポリエーテルや合成ゴムなどの適宜なポリマーをベースポリマーとする粘着剤などの適宜な粘着性物質を用いて形成することができる。就中アクリル系粘着剤の如く光学的透明性や耐候性、耐熱性等に優れて熱や湿度の影響で浮きや剥がれ等を生じにくいものが好ましく用いうる。

【００２７】ちなみに前記のアクリル系粘着剤の例としては、メチル基やエチル基やブチル基等の炭素数が２０以下のアルキル基を有する（メタ）アクリル酸のアルキルエステルと、（メタ）アクリル酸や（メタ）アクリル酸ヒドロキシエチル等の改良成分からなるアクリル系モノマーを、ガラス転移温度が０℃以下となる組合せにて共重合してなる、重量平均分子量が１０万以上のアクリル系重合体をベースポリマーとするものなどがあげられるが、これに限定されない。

【００２８】粘着層の形成は、例えばカレンダーロール法等による圧延方式、ドクターブレード法やグラビアロールコータ法等による塗工方式などの適宜な方式で粘着性物質をコレステリック液晶層等の形成素材に付設する

方式、あるいはそれに準じてセパレータ上に粘着層を形成しそれをコレステリック液晶層等の形成素材に移着する方式などの適宜な方式で行うことができる。

【００２９】なお粘着層は、それに透明粒子を含有させる方式などにより光拡散型のものとして形成することもできる。その透明粒子には、例えばシリカやアルミナ、チタニアやジルコニア、酸化錫や酸化インジウム、酸化カドミウムや酸化アンチモン等からなる、導電性のこともある無機系粒子、架橋又は未架橋のポリマー等からなる有機系粒子などの適宜なものを１種又は２種以上用いうる。

【００３０】図２の例の如く光学素子の外表面には必要に応じ液晶セル等の他部材との接着を目的とした粘着層３を設けることもできる。その粘着層が表面に露出する場合には実用に供するまでの間、汚染防止等の保護を目的にその表面をセパレータなどで仮着カバーしておくこともできる。また光学素子の形成素材が表面に露出する場合にはその露出表面を表面保護フィルムにて接着カバーして傷付き等から保護することもできる。

【００３１】前記のセパレータや表面保護フィルムは、光学素子の実用段階では剥離除去されその際に静電気やそれによるゴミ付着が生じる場合があるので必要に応じて帯電防止処理したセパレータや表面保護フィルムを用いることができる。また同様に例えば帯電防止層を光学素子の形成素材の層間や表面に位置させる方式などの適宜な方式で帯電防止処理した光学素子とすることもできる。

【００３２】光学素子は、各種の用途に用いることができ特に正面指向性の向上を目的とした面光源装置や輝度の向上を目的とした液晶表示装置の形成に好ましく用いうる。面光源装置は、例えば三波長管よりなる蛍光灯を光源とするサイドライト型や直下型等の面光源上に光学素子を配置する方式などにより形成することができる。また液晶表示装置は、例えば前記の面光源装置における光学素子の上側に必要に応じ偏光板等を介して適宜な液晶セルを配置する方式などにより形成することができる。その場合、光学素子が二色性偏光板を有するときにはそれを有しないコレステリック液晶層側が面光源側となるように配置される。

【００３３】前記において例えば波長約４４０nm、約５５０nm及び約６１０nmに輝線を示す三波長管よりなる汎用な蛍光灯（冷陰極管）を光源とする面光源を用いる場合、正面指向性に優れる面光源装置を得る点より好ましく用いうる光学素子は、円偏光の選択反射波長域が５５０～６１０nmの範囲内にあるコレステリック液晶層と、当該波長域が６１０nm以上、就中その短波長端が６１０～６３０nm程度で長波長端が大きいもの、従って当該波長域の短波長端が少なくとも６１０nmでその波長域が可及的に大きいもの、実用的には当該波長域が６１０～８００nmの範囲内にあるコレステリック液晶層との２種以上（円偏光の左右を逆転させる関係のコレステリック液晶層では合計４種以上）、特にそれらと当該波長域が４４０～５５０nmの範囲内にあるコレステリック液晶層との３種以上（円偏光の左右を逆転させる関係のコレステリック液晶層では合計６種以上）を用いて前記３種の輝線に対応した選択反射波長域を示すものである。

【００３４】前記のように正面指向性に優れる面光源装置を得る点より好ましく用いうる光学素子は、三波長管による輝線に対応した選択反射波長域を示すものである。さらに入射角が２０度超となる輝線を遮光し、入射角が２０度以内の正面指向性に優れる輝線を透過させる点よりは、上記した$\cos\theta$の関与による短波長側シフトに基づいて光源の各輝線よりも１０nm以上、就中１５～１００nm、特に２０～５０nm長い波長を選択反射波長域の短波長側の端とするコレステリック液晶層を用いた光学素子が好ましく用いられる。

【００３５】上記において光学素子で遮光されて面光源側に反射された光は光反射層を介して閉じ込めることができる。従ってその場合には、面光源の発光を遮ることなく光反射層を設けうるサイドライト型導光板等による面光源の使用が好ましい。導光板等の底面に光反射層を設けて前記遮光による反射光を光学素子と光反射層の間に閉じ込めることにより、その間に介在する導光板等による屈折や拡散ないし散乱等による光路変更で光学素子を透過しうる入射角の小さい光となり、それにより光学素子を正面指向性よく透過して輝度の向上を図ることができる。

【００３６】面光源装置や液晶表示装置の形成に際して光学素子は、面光源の発光面や液晶セルの視認面又は／及び背面等の適宜な位置に単に設置するだけであってもよいが、他部材とのスティッキングや耐熱性等の性能試験時などにおけるカール、ウネリの発生を防止する点などより粘着層等の透明接着層を介して面光源や液晶セル等に接着処理することが好ましい。なお面光源装置や液晶表示装置の形成に際しては、防眩層や反射防止層、光拡散層などの適宜な光学層の１層又は２層以上を適宜な位置に配置することができる。

【００３７】

【実施例】実施例１

厚さ８０μmの三酢酸セルロースフィルムの上にラビング配向膜を介しコレステリック液晶ポリマーを塗布し配向処理して選択反射波長域が５７０～６０５nmの左円偏光反射型及び右円偏光反射型のコレステリック液晶層を形成し、それらを厚さ２０μmのアクリル系粘着層を介し接着して光学素子を得た。

【００３８】実施例２

ポリカーボネートからなる１／２波長板の両側に厚さ２０μmのアクリル系粘着層を介して実施例１に準じた右円偏光反射型のコレステリック液晶層を接着して光学素子を得た。

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【００３９】実施例３

実施例１に準じ選択反射波長域が４６０～４８９nm、５７０～６０３nm又は６３０nm～６７０nmの左円偏光反射型及び右円偏光反射型のコレステリック液晶層を形成し、それらをアクリル系粘着層を介し接着積層して光学素子を得た。

【００４０】比較例

頂角が９０℃の市販プリズムシートを光学素子として用いた。

【００４１】評価試験

導光板の側面に輝線波長が４３８nmと５４５nmと６１０nmの三波長管よりなる蛍光灯を配置してなるサイドライト型面光源の発光面に光拡散シートを介し実施例、比較例で得た光学素子を載置して面光源装置を形成し輝度計（トプコン社製、ＢＭ７）にてその光学素子上の正面輝度を調べた。

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【００４２】前記の結果を次表に示した。

	正面輝度(cd／m²)
実施例１	１８０９
実施例２	１８００
実施例３	２２１０
比較例１	１６００

【図面の簡単な説明】

【図１】実施例の断面図

【図２】他の実施例の断面図

【符号の説明】

１、２：コレステリック液晶層

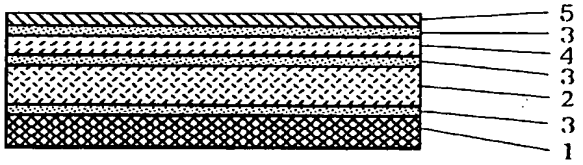
３：粘着層

４：二色性偏光板

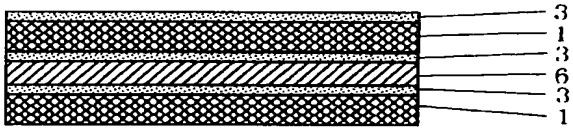
５：位相差板

６：１／２波長板

【図１】



【図２】



フロントページの続き

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BB51 BC22
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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical element of the Lyot filter mold which can form the liquid crystal display which is excellent in the surface light source equipment which emits light with sufficient transverse-plane directivity, or brightness.
[0002]
[Background of the Invention] Conventionally, the prism sheet was known as an optical element which raises the transverse-plane directivity of the emission light by the surface light source of a side light mold light guide plate etc., and can aim at improvement in transverse-plane brightness (JP,10-68804,A, JP,10-82902,A). A prism sheet is what carried out the array of the prism gestalt of Yamagata on the transparence base material, makes the light of the direction of slant refracted through the prism gestalt, and raises the transverse-plane directivity towards the direction of a transverse plane (perpendicular) of the surface light source. The method which condenses the light which superimposes the prism sheet of two or more sheets so that the direction of an array of the prism may cross, and is emitted in the many directions in the direction of a transverse plane is also learned. however, a prism sheet -- the prism gestalt -- contact etc. -- getting damaged -- easy -- the -- getting damaged -- since it became the cause of generating of the luminescent spot or the scotoma, the scarce trouble was in workability that cautions are required at the time of the assembly of surface light source equipment etc., and it is hard to deal with it. Moreover, when the prism sheet stuck with contiguity members, such as a film, at the time of practical use, there was also a trouble which a prism function falls and is easy to produce degradation.
[0003] On the other hand, as a means to attain high brightness-ization of a liquid crystal display etc., the method which arranges the optical element which consists of the cholesteric-liquid-crystal layer and quarter-wave length plate of GURANJAN orientation on the surface light source was also learned. This method controls the absorption loss by the polarizing plate, and it is made to raise brightness by circular-polarization-of-light-izing outgoing radiation light by the surface light source, linearly-polarized-light-izing it through a quarter-wave length plate using the property to divide into the circular polarization of light on either side the incidence natural light which said cholesteric-liquid-crystal layer shows as the reflected light and the transmitted light, and supplying a polarizing plate. Therefore, it does not contribute to improvement in transverse-plane directivity of the emission light by the surface light source.
[0004]
[The technical technical problem of invention] This invention makes a technical problem development of the optical element which can form the liquid crystal display which is excellent in the surface light source equipment which emits light with sufficient transverse-plane directivity, or brightness while it cannot produce damage on the degradation by adhesion with a contiguity member, or a gestalt easily and is excellent in handling workability.
[0005]
[Means for Solving the Problem] This invention becomes the same [the selective reflection wavelength

region of the circular polarization of light] about the cholesteric-liquid-crystal layer of GURANJAN orientation. And come to carry out a laminating in the combination which the right and left of the circular polarization of light by which selective reflection is carried out reverse. Or the optical element characterized by coming to carry out the laminating of the cholesteric-liquid-crystal layer concerned in the combination from which the selective reflection wavelength region of the circular polarization of light and the right and left of the circular polarization of light by which selective reflection is carried out become the same through 1/2 wavelength plate, And the surface light source equipment characterized by coming to arrange the fluorescent lamp which consists the optical element of three-wave tubing on the surface light source of the side light mold made into the light source or direct female mold, and the liquid crystal display characterized by coming to use the aforementioned optical element for a list are offered.
[0006]
[Effect of the Invention] According to this invention, the circular polarization of light of the method of Uichi Hidari of the specific wavelength region by the cholesteric-liquid-crystal layer of GURANJAN orientation is reflected alternatively, and based on the property made to penetrate and the combination over the circular polarization of light of the right and left, other light can carry out selective reflection of the light of said specific wavelength region, and can be shaded substantially. In addition, even if the combination over the circular polarization of light of said right and left is combination which the right and left of the circular polarization of light by which selective reflection is carried out reverse and from which it combines and is alike, in addition right and left of the circular polarization of light become the same, it can reverse right and left of the circular polarization of light by making 1/2 wavelength plate intervene, and can attain the purpose.
[0007] moreover, from the property which the wavelength region of selective reflection shifts with the relation of costheta at a short wavelength side according to the incident angle theta in a cholesteric-liquid-crystal layer in the aforementioned case being shown In the direction of a transverse plane (zero incident angle), the light of a predetermined wavelength region penetrates by controlling the selective reflection wavelength region of a cholesteric-liquid-crystal layer. When the light carries out incidence by the incident angle theta beyond a predetermined value, the aforementioned protection-from-light effectiveness shall be produced and only the light of the direction less than of constant value shall penetrate [a transverse plane and an incident angle].
[0008] Therefore, when the aforementioned incident angle theta combines the optical element which shows the protection-from-light effectiveness to the incident light beyond a predetermined value, and the surface light source to which light is emitted with the wavelength light from which the protection-from-light effectiveness is produced, the surface light source equipment which emits light with sufficient transverse-plane directivity can be formed, and the liquid crystal display which is excellent in brightness using it can be formed. Moreover, since the optical element by this invention does not have the gestalt which does not produce degradation and is easy to produce the damage on a projection etc. even if it sticks it with a contiguity member, it is excellent also in handling workability.
[0009]
[Embodiment of the Invention] The optical element by this invention consists of a thing which carried out the laminating of the cholesteric-liquid-crystal layer of GURANJAN orientation in the combination which right and left of the circular polarization of light by which the selective reflection wavelength region of the circular polarization of light becomes the same, and selective reflection is carried out reverse, or a thing to which the selective reflection wavelength region of the circular polarization of light and the right and left of the circular polarization of light by which selective reflection is carried out carried out the laminating of the cholesteric-liquid-crystal layer concerned through 1/2 wavelength plate in the combination which becomes the same. The example was shown in drawing 1 and drawing 2 . 1 and 2 are [a cholesteric-liquid-crystal layer and 6] 1/2 wavelength plates. Moreover, as for an adhesive layer and 4, 3 is [a dichroism polarizing plate and 5] phase contrast plates.
[0010] The cholesteric-liquid-crystal layer of GURANJAN orientation reflects alternatively the circular polarization of light computed in formula:lambda=n-P-cos theta based on the spiral pitch P by Bragg

reflection, and other light is penetrated (however, lambda is [the average refractive index (n= (ne+no)/2) of a cholesteric-liquid-crystal molecule and theta of the main wavelength of the reflected light and n] the incident angles of light). Right and left of the circular polarization of light reflected are determined by right and left of the direction of a spiral in the cholesteric-liquid-crystal layer of GURANJAN orientation. Moreover, selective reflection wavelength region **lambda is formed near the main wavelength lambda based on formula:**lambda=**n-P-costheta of refractive-index difference **n of liquid crystal.

[0011] In this invention, the cholesteric-liquid-crystal layer of GURANJAN orientation becomes the same [the selective reflection wavelength region of the circular polarization of light] like the example of drawing 1 , and it is used in the combination (1) it becomes the same the selective reflection wavelength region of the circular polarization of light and influencing [by which selective reflection is carried out / of the circular polarization of light] like the combination (1 2) which the right and left of the circular polarization of light by which selective reflection is carried out reverse, or the example of drawing 2 , and a laminating is carried out through 1/2 wavelength plate 6 in the combination from which right and left of the latter circular polarization of light become the same. the selective reflection wavelength region same by this -- setting -- right and left -- the optical element which reflects any circular polarization of light is formed, and transparency of the light of the wavelength region concerned is prevented. In addition, in the case of said latter, 1/2 wavelength plate will be reflected in a next cholesteric-liquid-crystal layer based on reversing right and left of the circular polarization of light which penetrated the previous cholesteric-liquid-crystal layer.

[0012] About the cholesteric-liquid-crystal layer of GURANJAN orientation to be used, especially limitation can use the proper thing which shows the property been [nothing] and described above. A cholesteric-liquid-crystal layer may be a single layer material, and although the thing from which the spiral pitch of GURANJAN orientation is different, therefore the wavelength region of selective reflection are different, it may have the arrangement structure which superimposed two-layer or three layers or more in combination. The wavelength region of selective reflection is expandable by this superposition-ization.

[0013] On the occasion of superposition of the above mentioned cholesteric-liquid-crystal layer of a spiral pitch difference, there is especially no limitation about the sequence of superposition based on the size of a spiral pitch, and it can consider as arbitrary superposition sequence. It is more advantageous than the point of the improvement in efficiency for light utilization, as a result the improvement in brightness to superimpose so that a spiral pitch may generally become as large and small sequence in many cases.

[0014] In addition, also when forming the optical element by the cholesteric-liquid-crystal layer of the combination which the above-mentioned right and left of the circular polarization of light by which selective reflection is carried out reverse Although the superposition method of the above mentioned cholesteric-liquid-crystal layer of a spiral pitch difference can be taken, in that case Although right and left of the circular polarization of light are reversed, a method with proper mutual superposition method, superposition unification method of the thing of the same direction of the circular polarization of light, etc. can be taken, and there is especially no limitation in the superposition method including the sequence of the size of a spiral pitch.

[0015] Although the cholesteric-liquid-crystal layer of GURANJAN orientation can also be obtained as a thing of the cel gestalt which ****(ed) low-molecular liquid crystal with the cel substrate, what was made into the shape of the shape of a film and a sheet rather than points, such as handling nature and thin-shape-izing, is used preferably. Cholesteric-liquid-crystal layers, such as the shape of a film, can be obtained as what attached the layer by the liquid crystal polymer which carried out GURANJAN orientation through the orientation film by rubbing processing etc. on the film by the liquid crystal polymer, and the transparence base material, a thing which attached the ultraviolet curing layer of the low-molecular liquid crystal which carried out GURANJAN orientation through the orientation film on the transparence base material. Moreover, the superposition layer of a cholesteric-liquid-crystal layer can be formed with a two coats method, the welding method of a special form living thing, etc. In addition, as for

the superposition layer of the cholesteric-liquid-crystal layer (right and left of the circular polarization of light are reversed) in which the direction of a spiral rolls, a form living thing can be separately performed through transparence glue lines, such as an adhesive layer.

[0016] About the ingredient which forms the aforementioned transparence base material, although there is especially no limitation, generally a polymer is used. As an example of the polymer, the cellulose system polymer like diacetyl cellulose or a cellulose triacetate, The polyester system polymer like polyethylene terephthalate or polyethylenenaphthalate, A polycarbonate system polymer and the acrylic polymer like polymethylmethacrylate, Polystyrene and the styrene system polymer like an acrylonitrile styrene copolymer, An olefin system polymer, a vinyl chloride system polymer, and nylon and the amide system polymer like aromatic polyamide like polyolefine or ethylene propylene rubber that have polyethylene, polypropylene, a cyclo system, or norbornene structure are raised.

[0017] Moreover, the polymer hardened by heat, UV irradiation, etc., such as the blend object of an imide system polymer, a sulfone system polymer, a polyether sulphone system polymer and a polyether ether ketone system polymer, a polyphenylene sulfide system polymer and a vinyl alcohol system polymer, a vinylidene-chloride system polymer and a vinyl butyral system polymer, an ant rate system polymer and a polyoxymethylene system polymer, an epoxy system polymer, or said polymer or a polyester system, acrylic, an urethane system and an amide system, a silicone system, and an epoxy system, can be used for formation of said transparence base material. A transparence base material with few birefringences is preferably excelled thru/or used for isotropy like a cellulose system film above all.

[0018] The right and left of the circular polarization of light by which selective reflection is carried out use the cholesteric-liquid-crystal layer 1 described above like the example of drawing 2 in the combination which becomes the same, and carry out a laminating through 1/2 wavelength plate 6. As 1/2 wavelength plate for reversing right and left of the transparency circular polarization of light The proper thing according to the former, such as what supported the form birefringence film which consists of an oriented film of various polymers etc., the oriented film of the **** liquid crystal polymer of a disco tic system or a nematic system, and its orientation liquid crystal layer on the transparence base material, can be used.

[0019] As for the polymer which forms the aforementioned form birefringence film, what was illustrated with the above-mentioned transparence base material may be proper. Above all, for example, a polyester system polymer and the polymer which is excellent in crystallinity like a polyether ether ketone can use preferably. An oriented film may be processed by the method with proper one shaft, two shafts, etc. Moreover, you may be the form birefringence film which controlled the refractive index of the thickness direction of a film by the method which gives a shrinkage force or/and the extension force to the bottom of adhesion with a heat shrink nature film. Although 1/2 wavelength plate made the optical axis cross and carried out the laminating of the phase contrast plate of a phase contrast difference for example, it may expand to a pan like and the wavelength region which functions as 1/2 wavelength plate.

[0020] Practical use can also be presented with an optical element through an adhesive layer 3 on the outside of the cholesteric-liquid-crystal layer of the outermost layer if needed with the dichroism polarizing plate 4 and the gestalt which pasted up the phase contrast plate more than one layer or two-layer on the side which has the dichroism polarizing plate further through the adhesive layer 3 like the example of drawing 1 . Handling workability of unification with this dichroism polarizing plate etc. can improve more, and it can be simplified like erectors, such as surface light source equipment and a liquid crystal display.

[0021] The aforementioned dichroism polarizing plate aims at acquiring the linearly polarized light for attaining a liquid crystal display etc. To the polarizing plate, the linearly polarized light of a predetermined polarization shaft can be penetrated, other light can use the proper thing to absorb, and there is especially no limitation about the class. What generally protected a polarization film, and its one side or both sides by transparent protection layer is used. Incidentally as an example of the polarization film, what iodine and/or dichromatic dye were made to stick to the hydrophilic high polymer film like a polyvinyl alcohol system film, a partial formal-ized polyvinyl alcohol system film, and an ethylene-

vinylacetate copolymer system partial saponification film, and carried out extension processing is raised.
[0022] Moreover, the transparent protection layer prepared in one side or both sides of a polarization film if needed can be formed in the polymer illustrated with the above-mentioned transparence base material. The transparent protection layer which consists of a polymer which is excellent in transparency, a mechanical strength and thermal stability, moisture electric shielding nature, etc. above all is desirable. Although transparent protection layer considered as the spreading method and film of polymer liquid, it can be formed by the method with a proper adhesion laminating method etc.
[0023] On the other hand, a phase contrast plate as occasion demands [above-mentioned] aims at compensating the phase contrast by the birefringence of a liquid crystal cell, and aiming at improvement in display grace etc. As for the phase contrast plate for this optical compensation, it is desirable to arrange so that it may be usually located between a dichroism polarizing plate and a liquid crystal cell from the point of improvement in display grace. What has the proper phase contrast which consists of a form birefringence film according to the 1/2 above-mentioned wavelength plate, an orientation liquid crystal layer, etc. as a phase contrast plate for optical compensation is used, and the laminating of the phase contrast layer more than two-layer may be carried out for the purpose of control of optical properties, such as phase contrast.
[0024] Moreover, the aforementioned phase contrast plate may be a quarter-wave length plate for linearly-polarized-light-izing the transparency circular polarization of light by which outgoing radiation is carried out from a cholesteric-liquid-crystal layer. In that case, the phase contrast plate which consists of a quarter-wave length plate is usually arranged between a cholesteric-liquid-crystal layer and a dichroism polarizing plate. An absorption loss can be prevented by supplying the light linearly-polarized-light-ized through the quarter-wave length plate so that the plane of vibration may be as much as possible in agreement with the transparency shaft of a dichroism polarizing plate, and brightness can be raised more. The aforementioned quarter-wave length plate may be a thing aiming at expansion of the wavelength region which functions as a quarter-wave length plate by the method superimposed on 1/2 wavelength plate etc.
[0025] Although each material, such as a cholesteric-liquid-crystal layer which forms an optical element, 1/2 wavelength plate and a dichroism polarizing plate as occasion demands, and a phase contrast plate, may only be piled up and you may place, it is more desirable than points by gap prevention of an optical axis, such as stabilization of quality, and improvement in the assembly effectiveness of a liquid crystal display, that laminating unification is carried out through transparence glue lines, such as an adhesive layer. Incidentally by the example of drawing, the adhesion unification of 1, 2, and 1/2 wavelength plate 6, the dichroism polarizing plate 4, and the phase contrast plate 5 of a cholesteric-liquid-crystal layer is carried out through the adhesive layer 3, respectively.
[0026] An adhesive layer can form proper polymers, such as for example, an acrylic polymer, a silicone system polymer and polyester, polyurethane and a polyether, and synthetic rubber, using proper slime, such as a binder made into a base polymer. What is excellent in optical transparency, weatherability, thermal resistance, etc., and can produce neither a float nor peeling easily due to the effect of heat or humidity can use preferably like an acrylic binder above all.
[0027] Incidentally as an example of the aforementioned acrylic binder The alkyl ester of the acrylic acid with which carbon numbers, such as a methyl group, an ethyl group, and butyl, have 20 or less alkyl group (meta), (Meta) Although that to which the weight average molecular weight which comes to copolymerize the acrylic monomer which consists of amelioration components, such as an acrylic acid and acrylic-acid (meta) hydroxyethyl, in the combination from which glass transition temperature becomes 0 degree C or less makes 100,000 or more acrylic polymers a base polymer is raised It is not limited to this.
[0028] A method with proper method which attaches slime to formation materials, such as a cholesteric-liquid-crystal layer, by the method with the proper coating method by the rolling method for example, by the calendering roll method etc., the doctor blade method, the gravure roll coater method, etc. or method which forms an adhesive layer on a separator according to it, and carries out transfer of it to formation materials, such as a cholesteric-liquid-crystal layer, etc. can perform formation of an adhesive layer.

[0029] In addition, an adhesive layer can also be formed as a thing of an optical diffusion mold with the method which makes it contain a transparence particle. proper things, such as an organic system particle which turns into the transparence particle from a silica, an alumina, a titania and a zirconia, tin oxide and indium oxide, cadmium oxide, antimony oxide, etc. and which a conductive thing also becomes from the polymer for which a bridge is not constructed [a certain inorganic system particle, bridge formation, or], -- one sort -- or two or more sorts can be used.
[0030] The adhesive layer 3 aiming at adhesion with other members, such as a liquid crystal cell, can also be formed in the outside surface of an optical element if needed like the example of drawing 2 . Tentative installation covering of the front face can also be carried out with a separator etc. for the purpose of protection of a pollution control etc. until it presents practical use, when the adhesive layer is exposed to a front face. moreover -- the case where the formation material of an optical element is exposed to a front face -- the exposure front face -- a surface-protection film -- adhesion covering -- carrying out -- getting damaged -- etc. -- from -- it can also protect.
[0031] In the practical use phase of an optical element, since exfoliation removal is carried out and the dust adhesion by static electricity or it may arise in that case, the separator and surface-protection film which carried out antistatic treatment if needed can be used for an aforementioned separator and an aforementioned surface-protection film. Moreover, it can also consider as the optical element which carried out antistatic treatment of the antistatic layer similarly by the method with the proper method located between the layers of the formation material of an optical element, and in a front face.
[0032] An optical element can be used for various kinds of applications, and can be especially used for formation of surface light source equipment aiming at the improvement in transverse-plane directivity, or the liquid crystal display aiming at improvement in brightness preferably. Surface light source equipment can be formed with the method which arranges an optical element on the surface light source of the side light mold which makes the light source the fluorescent lamp which consists for example, of three-wave tubing, direct female mold, etc. Moreover, a liquid crystal display can be formed with the method which arranges a proper liquid crystal cell through a polarizing plate etc. if needed to the optical element up side in above surface light source equipment. In that case, when an optical element has a dichroism polarizing plate, it is arranged so that the cholesteric-liquid-crystal layer side which does not have it may become a surface light source side.
[0033] When the surface light source which makes the light source the general-purpose fluorescent lamp (cold cathode tube) which consists of three-wave tubing which shows the bright line to the wavelength of about 440nm, about 550nm, and about 610nm in the above is used, The optical element which can be used more preferably than the point of obtaining the surface light source equipment which is excellent in transverse-plane directivity The cholesteric-liquid-crystal layer in within the limits whose selective reflection wavelength region of the circular polarization of light is 550-610nm, The short wavelength edge above all 610nm or more What has a large long wavelength edge at about 610-630nm, [the wavelength region concerned] The wavelength region as much as possible by at least 610nm Therefore, a large thing, [the short wavelength edge of the wavelength region concerned] Two or more (in the cholesteric-liquid-crystal layer of the relation which reverses right and left of the circular polarization of light, they are a total of four or more sorts) sorts with the cholesteric-liquid-crystal layer in within the limits whose wavelength region concerned is 610-800nm practical, The selective reflection wavelength region corresponding to said three sorts of bright lines is shown using three or more (in the cholesteric-liquid-crystal layer of the relation which reverses right and left of the circular polarization of light, they are a total of six or more sorts) sorts with the cholesteric-liquid-crystal layer in within the limits especially whose them and wavelength region concerned are 440-550nm.
[0034] The optical element which can be used more preferably than the point of obtaining the surface light source equipment which is excellent in transverse-plane directivity as mentioned above shows the selective reflection wavelength region corresponding to the bright line with three-wave tubing. further -- an incident angle -- 20 degrees -- super- -- ** -- the bright line is shaded and the optical element using the cholesteric-liquid-crystal layer which uses especially 10nm or more of 15-100nm of 20-50nm

long wave length as the edge by the side of the short wavelength of a selective reflection wavelength region above all rather than each bright line of the light source based on the short wavelength side shift by the intervention of above-mentioned costheta is preferably used rather than the point of making the bright line an incident angle excels [bright line] in the transverse-plane directivity of less than 20 degrees penetrating.

[0035] The light which was shaded by the optical element in the above and reflected in the surface light source side can be shut up through a light reflex layer. Therefore, use of the surface light source by the side light mold light guide plate which can prepare a light reflex layer is desirable in that case, without interrupting luminescence of the surface light source. By preparing a light reflex layer in bases, such as a light guide plate, and shutting up the reflected light by said protection from light between an optical element and a light reflex layer, it can become light with the small incident angle which may penetrate an optical element by optical-path modification by refraction by the light guide plate which intervenes between them, diffusion thru/or dispersion, etc., an optical element can be penetrated with sufficient transverse-plane directivity by that cause, and improvement in brightness can be aimed at.

[0036] Although an optical element may only be installed in the location where the luminescence side of the surface light source, the check-by-looking side of a liquid crystal cell, a tooth back, etc. are proper on the occasion of formation of surface light source equipment or a liquid crystal display, it is more desirable than the point of preventing the curl in the time of performance tests, such as sticking with other members, and thermal resistance, etc., and generating of a swell etc. to carry out adhesion processing through transparence glue lines, such as an adhesive layer, at the surface light source, a liquid crystal cell, etc. In addition, on the occasion of formation of surface light source equipment or a liquid crystal display, it can arrange more than two-layer [of proper optical layers, such as an anti-glare layer, and an acid-resisting layer, an optical diffusion layer, / one layer or two-layer] in a proper location.

[0037]

[Example] On the triacetic-acid cellulose film with an example 1 thickness of 80 micrometers, through the rubbing orientation film, the cholesteric-liquid-crystal polymer was applied, orientation processing was carried out, the cholesteric-liquid-crystal layer of the left-handed-circularly-polarized-light reflective mold whose selective reflection wavelength region is 570-605nm, and a right-handed-circularly-polarized-light reflective mold was formed, they were pasted up through the acrylic adhesive layer with a thickness of 20 micrometers, and the optical element was obtained.

[0038] The cholesteric-liquid-crystal layer of the right-handed-circularly-polarized-light reflective mold which applied to the example 1 correspondingly through the acrylic adhesive layer with a thickness of 20 micrometers at the both sides of 1/2 wavelength plate which consists of example 2 polycarbonate was pasted up, and the optical element was obtained.

[0039] According to example 3 example 1, the cholesteric-liquid-crystal layer of the left-handed-circularly-polarized-light reflective mold whose selective reflection wavelength region is 460-489nm, 570-603nm, or 630nm - 670nm, and a right-handed-circularly-polarized-light reflective mold was formed, the adhesion laminating of them was carried out through the acrylic adhesive layer, and the optical element was obtained.

[0040] The commercial prism sheet whose example vertical angle of a comparison is 90 degrees C was used as an optical element.

[0041] The optical element obtained in the example and the example of a comparison through the optical diffusion sheet to the luminescence side of the side light mold face light source which comes to arrange the fluorescent lamp with which bright-line wavelength consists of three-wave tubing (438nm, 545nm, and 610nm) was laid in the side face of an evaluation trial light guide plate, surface light source equipment was formed, and the luminance meter (the TOPCON CORP. make, BM7) investigated the transverse-plane brightness on the optical element.

[0042] The aforementioned result was shown in degree table.

	正面輝度(cd／㎡)
実施例１	１８０９
実施例２	１８００
実施例３	２２１０
比較例１	１６００

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The optical element characterized by coming to carry out a laminating in the combination about which the selective reflection wavelength region of the circular polarization of light becomes the same, and the right and left of the circular polarization of light by which selective reflection is carried out reverse the cholesteric-liquid-crystal layer of GURANJAN orientation.
[Claim 2] The optical element characterized by coming to carry out the laminating of the cholesteric-liquid-crystal layer of GURANJAN orientation in the combination from which the selective reflection wavelength region of the circular polarization of light and the right and left of the circular polarization of light by which selective reflection is carried out become the same through 1/2 wavelength plate.
[Claim 3] The optical element using the cholesteric-liquid-crystal layer which is in within the limits whose selective reflection wavelength region of the circular polarization of light is 550-610nm in claim 1 or 2, the cholesteric-liquid-crystal layer which is within the limits of 610-800nm, or them and the cholesteric-liquid-crystal layer which is within the limits of 440-550nm.
[Claim 4] The optical element which the dichroism polarizing plate pasted up on the outside of the cholesteric-liquid-crystal layer of the outermost layer through the adhesive layer in claims 1-3.
[Claim 5] The optical element which the phase contrast plate more than one layer or two-layer pasted up on the side which has a dichroism polarizing plate through the adhesive layer in claim 4.
[Claim 6] Surface light source equipment characterized by coming to arrange the fluorescent lamp which consists an optical element according to claim 1 to 5 of three-wave tubing on the surface light source of the side light mold made into the light source, or direct female mold.
[Claim 7] The liquid crystal display characterized by coming to use an optical element according to claim 1 to 5.

[Translation done.]

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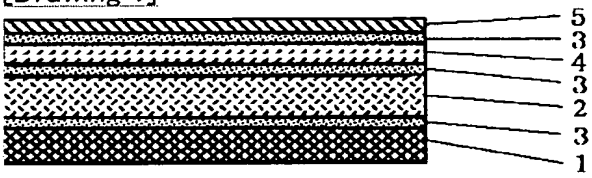
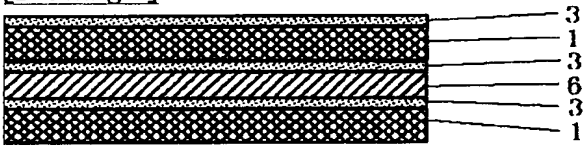
DRAWINGS

[Drawing 1]



[Drawing 2]



[Translation done.]